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A Comparison of Student Academic Performance with Traditional, Online, and Flipped Instructional Approaches in a C# Programming Course

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Abstract

Aim/Purpose	Compared student academic performance on specific course requirements in a C# programming course across three instructional approaches: traditional, online, and flipped.
Background	Addressed the following research question: When compared to the online and traditional instructional approaches, does the flipped instructional approach have a greater impact on student academic performance with specific course requirements in a C# programming course?
Methodology	Quantitative research design conducted over eight 16-week semesters among a total of 271 participants who were undergraduate students enrolled in a C# programming course. Data collected were grades earned from specific course requirements and were analyzed with the nonparametric Kruskal Wallis H-Test using IBM SPSS Statistics, Version 23.
Contribution	Provides empirical findings related to the impact that different instructional approaches have on student academic performance in a C# programming course. Also describes implications and recommendations for instructors of programming courses regarding instructional approaches that facilitate active learning, student engagement, and self-regulation.
Findings	Resulted in four statistically significant findings, indicating that the online and flipped instructional approaches had a greater impact on student academic performance than the traditional approach.
Recommendations for Practitioners	Implement instructional approaches such as online, flipped, or blended which foster active learning, student engagement, and self-regulation to increase student academic performance.

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Recommendation for Researchers	Build upon this study and others similar to it to include factors such as gender, age, ethnicity, and previous academic history.
Impact on Society	Acknowledge the growing influence of technology on society as a whole. Higher education coursework and programs are evolving to encompass more digitally-based learning contexts, thus compelling faculty to utilize instructional approaches beyond the traditional, lecture-based approach.
Future Research	Increase the number of participants in the flipped instructional approach to see if it has a greater impact on student academic performance. Include factors beyond student academic performance to include gender, age, ethnicity, and previous academic history.
Keywords	flipped instructional approach, online instructional approach, traditional instructional approach, C# programming, student performance, information technology education

INTRODUCTION

Although higher education faculty utilize various instructional approaches, the concept of 'flipping' the classroom has become quite popular across multiple disciplines. As described by Chen, Wang, Kinshuk, and Chen (2014), the flipped instructional approach transforms the traditional classroom instructional approach by reversing "in-class lectures with collaborative hands-on activities" (p. 17). In a flipped classroom, students watch recorded video lectures at home and are engaged in interactive group learning experiences during their scheduled class time. The fundamental premise of the flipped class is to move content typically covered in a classroom lecture to an online format (e.g., video lectures, voice-over PowerPoint®, SoftChalk® presentations, and podcasts). By doing so, the instructor is able to utilize class time for active learning assignments, student collaboration, and one-on-one interactions with students. While the flipped classroom has experienced a recent surge in popularity, it is not a novel idea. Lage, Platt, and Treglia (2000) previously described "inverting" the classroom (p. 32), and Strayer (2007) referred to instances where an instructor may interchange activities that are employed in and beyond the classroom.

Bergmann and Sams (2012) have been credited with initiating the modern flipped classroom movement in 2007 during their high school chemistry classes. The impetus for their implementation of the flipped classroom instructional approach was to accommodate high school athletes who frequently missed class due to participation in school-based sports programs. In order to provide these students the subject area content that was being missed, Bergmann and Sams created voice-over PowerPoint presentations of their classroom lectures and shared them with students who missed class. Bergmann and Sams also augmented these flipped components with tutorial sessions that consisted of mini-lectures and targeted instruction based on the needs of the students. As a result of these efforts, Bergmann and Sams discovered that the flipped instructional approach enhanced their interactions with students, as well as interactions among peers. Bergmann and Sams (2012) noted:

> Flipping the classroom has transformed our teaching practice. We no longer stand in front of our students and talk at them for 30 to 60 minutes at a time. This radical change has allowed us to take on a different role with our students. (p. 19)

Since then, the flipped classroom has expanded well beyond the high school context into various disciplines within higher education:

- actuarial studies (Butt, 2014);
- biology (Moravec, Williams, Aguilar-Roca, & O'Dowd, 2010; Porcaro, Jackson, McLaughlin, & O'Malley, 2016; Wright, Newman, Cardinale, & Teese, 2016);
- business (Burford & Chan, 2017; Findlay-Thompson & Mombourquette, 2014; Guy & Marquis, 2016; Huang & Lin, 2017);

- cinema and television arts (Enfield, 2013, 2016);
- computer science (Fetaji, Fetaji, Sukic, Gylcan, & Ebibi, 2016; Giannakos, Krogstie, & Aalberg, 2016; Reza & Ijaz Baig, 2015);
- English language instruction (Yang, 2017);
- engineering (Kecskemety, Corrigan, & Abrams, 2015; Lucke, Dunn, & Christie, 2017; Yelamarthi, K., Drake, E., & Prewett, 2016; Yusong & Daher, 2017);
- operations management (Asef-Vaziri, 2015; Pragman, 2014; Prashar, 2015);
- pharmacy (Cotta, Shah, Almgren, Macías-Moriarity, & Mody, 2016; Ferreri & O'Connor, 2013; Patanwala, Erstad, & Murphy, 2017);
- psychology (Hudson et al., 2015; Talley & Scherer, 2013; Wilson, 2013);
- statistics and quantitative analysis (Phillips & Phillips, 2016; Strayer, 2012; Swart & Wuensch, 2016); and
- teacher training (Ng, 2016).

These studies are only a small representation of literature available among various disciplines regarding effectiveness of the flipped instructional approach. As noted by Goodwin and Miller (2013), the vast majority of available literature published prior to 2013 reported nonscientific data, such as instructor and student insights and perspectives. However, examination of more recent works revealed a growing scientific research base for the flipped instructional approach, particularly within the discipline of information systems education (e.g., Frydenberg, 2013; Guy & Marquis, 2016; Tanner & Scott, 2015; Urbaczewski, 2013).

Although non-scientific literature has value and informs higher education faculty about pedagogical innovations, it is equally important to balance instructional design considerations with direct scientific research (Kuhn & Rundle-Thiele, 2009). Accordingly, the purpose of the present study was to extend the growing scientific research base for flipped instruction by exploring the impact of the three most commonly used instructional approaches (i.e., traditional, online, and flipped) within the context of information systems education. Specifically, this paper presents findings that explored the impact of instructional approach on student academic performance with specific course requirements in an undergraduate C# programming course.

LITERATURE REVIEW

Over the past few years, research exploring the use of the flipped instructional approach in information systems courses includes:

- Introduction to Computer Information Systems (Baker & Hill, 2016; Burns, Duncan, Sweeney, North, & Ellegood, 2013);
- Management Information Systems (Adkins, 2014; Guy & Marquis, 2016; Law, 2014);
- Programming (Fryling, Yoder, & Breimer, 2016; Mok, 2014; J. H. Sharp, 2016);
- Spreadsheets (Davies, Dean, & Ball, 2013; Frydenberg, 2013; Urbaczewski, 2013); and
- Systems Analysis and Design (Saulnier, 2015; Tanner & Scott, 2015).

These studies have largely utilized quantitative and mixed methods research designs to investigate the impact that the flipped instructional approach has on teaching and learning. The following literature reviewed presented evidence that the flipped instructional approach has the potential to increase levels of engagement and improve academic performance among students enrolled in information systems courses.

INCREASED ENGAGEMENT

Several studies within information systems education have also pointed to increased levels of engagement among students in classes that utilized the flipped instructional approach. For example, Frydenberg (2013) implemented the flipped instructional approach in an introductory information technology undergraduate course. In this approach, students viewed instructional videos prior to class and completed collaborative activities in small groups during class. While students worked in their groups during class, the instructor monitored their progress and provided assistance when needed. Results from a post-survey administered to students after participating in ten flipped sessions demonstrated favorable responses towards this instructional approach. Students indicated that they appreciated the challenge inherent with the collaborative activities and felt more connected to their peers. Guy and Marquis (2016) reported similar findings when they compared student performance in a traditional classroom environment to a flipped classroom environment among undergraduate business majors enrolled in a required Management Information Systems course. Based upon their findings, Guy and Marquis observed that students in the flipped classroom demonstrated higher levels of commitment to studying course content and materials than students in the traditional classroom. Moreover, students in the flipped classroom indicated that this instructional approach was "enjoyable and more responsive to their learning needs" (p. 10).

Similar findings were reported in studies that explored use of the flipped instructional approach in advanced undergraduate courses. For example, Mok (2014) examined student perceptions of the flipped instructional approach in an object-oriented advanced programming course. Similar to Frydenberg (2013), Mok (2014) shifted the lecture portion of the course to videos that students were required to view at home. As a result of this shift, class time was dedicated to pair programming activities. Mok noted that the flipped instructional approach increased levels of engagement among students and fostered the development of a "close community of learners" (p. 9).

INCREASED ACADEMIC PERFORMANCE

Research has also demonstrated the potential for the flipped instructional approach to increase academic performance among students. For example, Day and Foley (2006) compared student academic performance between students enrolled in two different sections of a human-computer interaction course. In one section, students experienced the traditional instructional approach, while students in the second section experienced the flipped instructional approach. Findings showed that students enrolled in the flipped section outperformed students enrolled in the traditional section on all course assignments and assessments, as well as with final course grades. Similarly, Guy and Marquis (2016) reported that students in flipped classrooms earned higher quiz and exam grades than students enrolled in traditional classrooms. Additional research has also suggested that the inclusion of supplemental instructional resources in a flipped classroom, such as audio lectures and lecture notes, has a positive effect on student academic performance (Adkins, 2014).

This review of literature consulted a select number of representative studies from information systems education that identified scalability, enhanced levels of engagement, and increased academic performance as positive outcomes associated with use of the flipped instructional approach. Among these reported findings, the majority of results focused on anecdotal observations made by the instructor (Davies et al., 2013; Guy and Marquis, 2016; Mok, 2014) and student-reported perceptions of their experiences that reported favorable preferences related to the flipped classroom (Frydenberg, 2013; Guy & Marquis, 2016).

METHODOLOGY

This study sought to extend previously published empirical findings by comparing student academic performance in an information systems education course that was delivered using all three commonly used instructional approaches: traditional, online, and flipped. With this in mind, the following research question guided the present study:

> When compared to the online and traditional instructional approaches, does the flipped instructional approach have a greater impact on student academic performance with specific course requirements in a C# programming course?

Specific details related to the methods used in this teaching and learning inquiry are addressed in this section.

PARTICIPANTS

Participants consisted of a total of 271 undergraduate students enrolled in an introductory C# programming course. The course is required for all Computer Information Systems (CIS) majors pursuing the Bachelor of Science or Bachelor of Business Administration degree in CIS. The majority of students participating were CIS majors, but other disciplines were represented. The present study included the following eight 16-week semesters: Fall 2012, Spring 2013, Fall 2013, Spring 2014, Fall 2014, Spring 2015, Fall 2015, and Spring 2016. Format of instructional approach (i.e., traditional, online, flipped) for course sections offered each semester was predetermined by the professor and students self-enrolled in the course section of their choice. The same professor taught all course sections using the same textbook, quizzes, assignments, and exams. Students who dropped, withdrew, or failed the course because they did not complete any course requirements were not included in the research sample. A summary of participants by instructional approach is provided in Table 1.

Table 1. Participants by instructional approach

Instructional Approach	Number of Students
Traditional	136
Online	96
Flipped	39
Total	**271**

CONTEXT

The present study compared student academic performance with specific course requirements in an undergraduate C# programming course delivered via traditional, online, and flipped instructional approaches. The course adhered to object-oriented paradigm. The course content included major topics including Window Forms Application development, variables, data types, calculations, input/output, named constants, exception handling, relational and logical operators, control structures, methods, arrays, and lists. See Appendix A for a detailed list of topics covered in each chapter. A brief description of the context for each instructional approach and the specific course requirements are provided below.

The traditional instructional approach utilized the common practice of the professor lecturing on programming concepts during face-to-face class meetings. During each lecture, the professor led students step-by-step through a representative example of the concept being addressed. After each lecture, students were then assigned a related lab assignment to complete at home. Students also completed multiple-choice quizzes related to material presented in the course text.

The online instructional approach delivered all of the course content in a distance learning format by proxy of a learning management system (LMS). The course content was delivered via voice-over PowerPoint presentations, professor-created videos, and publisher-provided videos. Students completed lab assignments independently and submitted them online to a designated area located in the LMS. Additionally, students completed multiple-choice quizzes related to material presented in the course text.

The flipped instructional approach used elements of the online instructional approach to deliver lectures for course topics and provided students with opportunities to practice and demonstrate mastery with course content at home. The professor created a comprehensive set of video demonstrations covering C# programming concepts using Adobe Captivate®, which allowed for the authoring and editing of video content. Video content included software demonstrations, software simulations, and voice-over-PowerPoint presentations that addressed each course topic (see Appendix A). These professor-created videos were posted in the LMS and deployed at designated times during the semester. At home, students accessed and viewed these videos prior to class and completed assigned course text readings, quizzes, and lab assignments related to content presented in the videos (see Appendix B).

The flipped instructional approach also reversed the traditional instructional approach by incorporating collaborative, hands-on activities during class that extended concepts students encountered prior to class through the videos, course text, quizzes, and lab assignments. These structured, in-class activities were designed to foster active learning among students through engagement with course content in collaborative peer groups. While students engaged with in-class activities, the professor acted as a moderator and guide.

All three instructional approaches utilized lab assignments, quizzes, exams, and a final exam as required course activities from which overall course averages were calculated. The exams consisted of hand-on programming assignments covering the topics from the associated chapters, videos, and lab assignments. The students were given a problem statement and were required to create an application from scratch to satisfy those requirements. For the present study, lab assignment scores, exam scores, final exam scores, and overall course averages served as items for comparison with which to measure student academic performance. The professor determined that each of these course requirements was rigorous and provided an accurate measure of student understandings with specific concepts addressed in the course. Although quiz scores were included in overall course average calculations, the professor utilized them as an accountability tool for students to complete assigned course text readings. Overall course averages were weighted and calculated in the following manner:

- Chapter quizzes – 10% of overall course average,
- Final exam – 20% of overall course average,
- Exams – 30% of overall course average, and
- Lab assignments – 40% of overall course average.

Data Collection and Analyses

Data were collected each semester and included lab assignment scores, exam scores, final exam scores, and overall course averages for all participants. Through the LMS, the professor generated Excel spreadsheet grade books for each course section from each semester included in data analyses. The data were then merged by instructional approach (i.e., traditional, online, and flipped) and compiled into IBM SPSS Statistics, Version 23 software for subsequent analyses.

A very common inferential statistical test conducted for determining statistically significant differences between two or more independent, unrelated groups is the one-way analysis of variance or ANOVA, which is a parametric test. As such, the professor conducted a cursory examination of the data set to determine the existence of significant outliers, normal distribution, and homogeneity of variances. Based upon this examination, the professor determined that the assumptions for performing a one-way ANOVA statistical analysis were not met. Due to these findings and the small sample size for the flipped instructional approach the Kruskal-Wallis H test was selected for conducting the statistical analysis. The Kruskal-Wallis H test is a rank-based nonparametric test that can be used to determine if there are statistically significant differences between two or more groups of an independent variable on a continuous or ordinal dependent variable. Analysis of the data indicated that the first three assumptions of the Kruskal-Wallis H Test were met. Assumption four addresses whether or not the distributions for each group of the independent variable have the same shape or a different shape. If the shape of the distributions are the same, the Kruskal-Wallis H test can be used to determine whether there are differences in the medians of the groups. While the Kruskal-Wallis H test allows you to determine whether there is an overall effect of your independent variable on your dependent variable, it does not inform you which of the groups differ from each other. Post hoc testing is utilized to determine which groups differ from each other.

Therefore, data were analyzed with the nonparametric Kruskal-Wallis H Test to determine whether statistically significance differences existed between each selected course requirements (i.e., lab assignments, exams, final exams, and overall course averages) in the C# programming course based upon instructional approach (i.e., traditional, online, and flipped). The following null hypothesis guided data analysis for each selected course requirement:

- H_0: The distribution of student academic performance is the same across each instructional approach.

FINDINGS

Data analyses revealed four statistically significant findings among the selected course requirements (see Tables 2 & 3). Therefore, these findings rejected the null hypotheses for the following selected course requirements:

- Lab Assignment 2: χ^2 (2, N = 271) = 6.42, p = .04);
- Lab Assignment 4: χ^2 (2, N = 271) = 8.16, p = .02);
- Exam 1: χ^2 (2, N = 271) = 20.02, p = .00); and
- Overall Course Average: χ^2 (2, N = 271) = 7.47, p = .02).

Table 2. Overview of all results

Course Requirement	$\chi^2(2)$	*p*
Lab Assignment 2	6.42	.04*
Lab Assignment 3	1.62	.45
Lab Assignment 4	8.16	.02*
Lab Assignment 5	1.30	.52
Lab Assignment 6	2.41	.30
Lab Assignment 7	1.88	.39
Exam 1	20.02	.00*
Exam 2	3.57	.17
Final Exam	2.60	.27
Overall Course Average	7.47	.02*

*Indicates statistically significant findings.

Table 2 provides an overview of the statistical testing results by displaying the chi-squared or x^2 distribution, indicating the degrees of freedom as k – 1, where k is equal to the number of groups and the p-value indicating statistically significant results with the asterisk.

Table 3. Course requirements with significant findings

Course Requirement	*N*	Median	Mean Rank	$\chi^2(2)$	*df*	*p*
Lab Assignment 2				6.42	2	.04
Traditional	136	96.00	130.76			
Online	96	95.50	131.57			
Flipped	39	99.00	165.19			
Lab Assignment 4				8.16	2	.02
Traditional	136	83.00	123.53			
Online	96	93.75	153.34			
Flipped	39	88.00	136.82			

Course Requirement	*N*	Median	Mean Rank	$\chi^2(2)$	*df*	*p*
Exam 1				20.02	2	.00
Traditional	136	93.00	135.60			
Online	96	90.00	117.19			
Flipped	39	97.50	183.68			
Overall Course Average				7.47	2	.02
Traditional	136	83.50	123.05			
Online	96	88.50	149.03			
Flipped	39	87.00	149.09			

Table 3 summarizes the course requirements resulting in statistically significant results by showing the population, median, mean rank, chi-squared distribution, degrees of freedom, and p-value. To explore these significant findings further, follow-up post hoc analyses evaluated pairwise differences between each instructional approach (see Table 4). Results from these analyses indicated the following:

- Lab Assignment 2: A statistically significant difference existed between the traditional and flipped instructional approaches. Lab 2 Assignment median scores were higher for students exposed to the flipped instructional approach than students exposed to the traditional instructional approach.
- Lab Assignment 4: A statistically significant difference existed between the traditional and online instructional approaches. Lab 4 Assignment median scores were higher for students exposed to the online instructional approach than students exposed to the traditional instructional approach.
- Exam 1: Statistically significant differences existed between the (a) traditional and flipped instructional approaches and (b) online and flipped instructional approaches. Exam 1 median scores were higher for students exposed to the flipped instructional approach than students exposed to the traditional and online instructional approaches.
- Overall Course Average: A statistically significant difference existed between the traditional and online instructional approaches. Overall Course Average median scores were higher for students exposed to the online instructional approach than students exposed to the traditional instructional approach.

Table 4. Post hoc findings

Course Requirement	Test Statistic	Std. Error	Adj. Sig.
Lab Assignment 2			
Traditional-Online	-.81	10.37	1.00
Traditional-Flipped	-34.44	14.13	.04*
Online-Flipped	-33.63	14.77	.07
Lab Assignment 4			
Traditional-Online	-13.30	14.22	1.00
Traditional-Flipped	-29.81	10.44	.01*
Online-Flipped	16.52	14.87	.80
Exam 1			
Traditional-Online	18.41	10.43	.23
Traditional-Flipped	-66.49	14.86	.00*
Online-Flipped	-48.08	14.22	.00*
Overall Course Average			
Traditional-Online	-25.98	10.44	.04*
Traditional-Flipped	-26.04	14.23	.20
Online-Flipped	-.06	14.87	1.00

*Indicates statistically significant findings.

DISCUSSION

Analyses of data revealed four statistically significant findings among the following selected course requirements: Lab Assignment 2, Lab Assignment 4, Exam 1, and Overall Course Average. With respect to the statistically significant finding associated with Lab Assignment 2, student academic performance was greater among those exposed to the flipped instructional approach when compared to students exposed to the traditional instructional approach. Similarly, both statistically significant findings associated with Exam 1 revealed greater student academic performance among those exposed to the flipped instructional approach when compared to students exposed to the traditional and online instructional approaches. With the flipped instructional approach, student median exam scores were higher than with the other two instructional approaches. These lab and exam findings have suggested that student learning increases when instructors "flip" the traditional instructional approach and cultivate an engaging and collaborative classroom learning environment. In the present study, students exposed to the flipped instructional approach completed assigned course text readings, quizzes, and lab assignments at home, which permitted the instructor to utilize in-class time to facilitate structured, collaborative activities. As previous literature has indicated, the flipped instructional approach employs a more student-centric instructional design that enhances interactions among the course instructor and peers (Bergmann & Sams, 2012; Frydenberg, 2013; Guy & Marquis, 2016; Mok, 2014; Tanner & Scott, 2015). Thus, the significant findings reported in the present study have added additional empirical data that aligns the notion that the flipped instructional approach "is more effective than instructor-centric approaches" (Zhang, Zhang, Stafford, & Zhang, 2013, p. 53).

Among course sections that employed the flipped instructional approach in the present study, the professor moved the lecture portion associated with each concept outside of the classroom. By doing so, the professor was able to utilize scheduled class meetings as designated times for students to participate in structured, hands-on collaborative tasks with which to develop deeper understandings of course content. The flipped instructional approach has also been shown to cultivate a stronger sense of ownership (Mok, 2014) and participation (J. H. Sharp, 2016) among students. As students participate in active learning experiences during class time that was once devoted to sit-and-get lectures, they are encouraged to interact with course content in ways that are meaningful and relevant to them (Baker & Hill, 2016). Moreover, students who have participated in flipped information systems courses have overwhelmingly reported positive experiences (Baker & Hill, 2016; Davis et al., 2013; Frydenberg, 2013; Mok, 2014; J. H. Sharp, 2016). Thus, combining previous findings in the literature with the empirical findings reported in the present study has suggested that the flipped instructional approach may provide the structure needed for professors of information systems to integrate active learning components in their courses effectively (Mitchell, Petter, & Harris, 2017).

Findings from the present study also revealed interesting results related to the online instructional approach. With the respect to the statistically significant findings associated with Lab Assignment 4 and Overall Course Average, student academic performance was greater among those exposed to the online instructional approach when compared to students exposed to the traditional instructional approach. Although this finding aligned with previously published literature that reported similar findings (e.g., Atchley, Wingenbach, & Akers, 2013; Cavanaugh & Jacquemin, 2015), there are a larger number of studies that presented divergent results (e.g., Burns et al., 2013; He & Yen, 2014; Helms, 2014). Based upon this discrepancy, it is clear that additional research is needed to further compare student academic performance between these two instructional approaches. In order to strengthen implications resulting from any significant findings, future research endeavors should utilize robust research designs that also consider factors beyond student academic performance, such as gender, age, ethnicity, and previous academic history.

CONCLUSION

The purpose of the present study was to extend the growing scientific research base for flipped instruction concerning use of the flipped instructional approach in higher education among information systems education courses. The present study explored the impact of three different instructional approaches (i.e., traditional, online, and flipped) on student academic performance with specific course requirements in an undergraduate C# programming course. Findings revealed greater student academic performance with specific course requirements among students exposed to the flipped and online instructional approaches. These findings are promising because higher education coursework and programs have evolved to encompass more digitally-based learning contexts (Hoskins, 2011). With this in mind, higher education faculty must become more familiar with instructional designs to deliver coursework at a distance in a way that promotes student success (Linder-VanBerschot & Summers, 2015; Scanlon, McAndew, & O'Shea, 2015). A clear limitation of the study is the small sample size for the flipped instructional approach in comparison to the traditional and online instructional approaches. The authors attempted to limit the impact of this issue in terms of determining statistically significant differences between the instructional approaches by selecting the non-parametric, Kruskal-Wall H Test rather than the parametric, one-way ANOVA. Increasing the sample size for the flipped instructional approach for future research will certainly strengthen the findings.

Higher education faculty who are new and unfamiliar with the flipped or online instructional approaches should also be aware of the following challenges. First, a flipped or online course should use videos to deliver course lectures virtually. Although much literature has recommended that instructor-created videos are optimal, creating these videos can be extremely time-consuming for the instructor (Fryling et al., 2015; J. H. Sharp & Schultz, 2013). Additionally, if the videos align closely with the required course text, switching courses texts or using updated course text editions may affect the relevance of content captured in video lectures. Furthermore, using flipped and online instructional approaches places more accountability on students to complete required tasks (Adkins, 2014). Being that so many students still experience traditional instructional approaches in their higher education coursework, instructors should consider embedding self-regulatory strategies in their flipped and online courses to support students who are new and inexperienced with the flipped instructional approach (L. A. Sharp & Sharp, 2016). Through modeling, periodic reminders, as well as other support mechanisms, instructors are positioned to scaffold student success in a digitally-based learning context.

REFERENCES

Adkins, J. (2014). Relevance of student resources in a flipped MIS classroom. *Information Systems Education Journal, 12*(2), 4-9. Retrieved from http://isedj.org/

Asef-Vaziri, A. (2015). The flipped classroom of operations management: A not-for-cost-reduction platform. *Decision Sciences Journal of Innovative Education, 13*(1), 71-89. doi:10.1111/dsji.12054

Atchley, W., Wingenbach, G., & Akers, C. (2013). Comparison of course completion and student performance through online and traditional courses. *International Review of Research in Open and Distance Learning, 14*(4), 104-116. doi:10.19173/irrodl.v14i4.1461

Baker, E. W., & Hill, S. (2016). Investigating student resistance and student perceptions of course quality and instructor performance in a flipped information systems classroom. *Proceedings of the Second EDSIG Conference on Information Systems and Computing Education, 2*(4057), 1-10. Retrieved from http://proc.iscap.info/2016/

Bergmann, J., & Sams, A. (2012). *Flip your classroom: Reach every student in every class every day*. Arlington, VA: ISTE.

Burford, M. R., & Chan, K. (2017). Refining a strategic marketing course: Is a 'flip' a good 'fit'? *Journal of Strategic Marketing, 25*(2), 152-163. doi:10.1080/0965254X.2016.1182578

Burns, K., Duncan, M., Sweeney II, D. C., North, J. W., & Ellegood, W. A. (2013). A longitudinal comparison of course delivery modes of an introductory information systems course and their impact on a subsequent information systems course. *Journal of Online Learning & Teaching, 9*(4), 453-467. Retrieved from http://jolt.merlot.org/

Butt, A. (2014). Student views on the use of a flipped classroom approach: Evidence from Australia. *Business Education & Accreditation, 6*(1), 33-43. Retrieved from http://www.theibfr.com/bea.htm

Cavanaugh, J. K., & Jacquemin, S. J. (2015). A large sample comparison of grade based student learning outcomes in online vs. face-to-face courses. *Online Learning, 19*(2), 25-32. Retrieved from https://olj.onlinelearningconsortium.org/index.php/olj/index

Chen, Y., Wang, Y., Kinshuk, & Chen, N. (2014). Is FLIP enough? Or should we use the FLIPPED model instead? *Computers & Education, 79*, 16-27. doi:10.1016/j.compedu.2014.07.004

Cotta, K. I., Shah, S., Almgren, M. M., Macías-Moriarity, L. Z., & Mody, V. (2016). Effectiveness of flipped classroom instructional model in teaching pharmaceutical calculations. *Currents in Pharmacy Teaching and Learning, 8*(5), 646-653. doi:10.1016/j.cptl.2016.06.011

Davies, R. S., Dean, D. L., & Ball, N. (2013). Flipping the classroom and instructional technology integration in a college-level information systems spreadsheet course. *Educational Technology Research & Development, 61*, 563-580. doi:10.1007/s11423-013-9305-6

Day, J. A., & Foley, J. D. (2006). Evaluating a web lecture intervention in a human-computer interaction course. *IEEE Transactions on Education, 49*(4), 420-431. doi:10.1109/TE.2006.879792

Enfield, J. (2013). Looking at the impact of the flipped classroom model of instruction on undergraduate multimedia students at CSUN. *TechTrends: For Leaders in Education & Training, 57*(6), 14-27. doi:10.1007/s11528-013-0698-1

Enfield, J. (2016). The value of using an e-text in a flipped course. *Techtrends: For Leaders in Education & Training, 60*(5), 449-455. doi:10.1007/s11528-016-0100-1

Ferreri, S. P., & O'Connor, S. K. (2013). Redesign of a large lecture course into a small-group learning course. *American Journal of Pharmaceutical Education, 77*(1), 1-9. doi:10.5688/ajpe77113

Fetaji, M., Fetaji, B., Sukic, C., Gylcan, A., & Ebibi, M. (2016). Case study analyses of the impact of flipped learning in teaching programming robots. *TEM Journal, 5*(4), 560-565. doi:10.18421/TEM54-21

Findlay-Thompson, S., & Mombourquette, P. (2014). Evaluation of a flipped classroom in an undergraduate business course. *Business Education & Accreditation, 6*(1), 63-71. Retrieved from http://www.theibfr.com/bea.htm

Frydenberg, M. (2013). Flipping Excel. *Information Systems Education Journal, 11*(1), 63-73. Retrieved from http://isedj.org/

Fryling, M., Yoder, R., & Breimer, E. (2016). Full flip, half flip, and no flip: Evaluation of flipping an introductory programming course. *Information Systems Education Journal, 14*(5), 4-16. Retrieved from http://isedj.org/

Giannakos, M. N., Krogstie, J., & Aalberg, T. (2016). Video-based learning ecosystem to support active learning: Application to an introductory computer science course. *Smart Learning Environments, 3*(1), 1-13. doi:10.1186/s40561-016-0036-0

Goodwin, B., & Miller, K. (2013). Evidence on flipped classrooms is still coming in. *Educational Leadership, 70*(6), 78-80. Retrieved from http://www.ascd.org/publications/educational-leadership.aspx

Guy, R., & Marquis, G. (2016). The flipped classroom: A comparison of student performance using instructional videos and podcasts versus the lecture-based model of instruction. *Issues in Informing Science and Information Technology, 13*, 1-13. Retrieved from https://www.informingscience.org/Publications/3461

He, W., & Yen, C. (2014). The role of delivery methods on the perceived learning performance and satisfaction of IT students in software programming courses. *Journal of Information Systems Education, 25*(1), 23-33. Retrieved from http://jise.org/index.html

Helms, J. L. (2014). Comparing student performance in online and face-to-face delivery modalities. *Journal of Asynchronous Learning Networks, 18*(1), 147-160. doi:10.24059/olj.v18i1.348

Hoskins, B. (2011). Demand, growth, and evolution. *Journal of Continuing Higher Education, 59*(1), 57-60. doi:10.1080/07377363.2011.546267

Huang, C., & Lin, C. (2017). Flipping business education: transformative use of team-based learning in human resource management classrooms. *Educational Technology & Society, 20*(1), 323-336. Retrieved from http://www.ifets.info/

Hudson, D. L., Whisenhunt, B. L., Shoptaugh, C. F., Visio, M. E., Cathey, C., & Rost, A. D. (2015). Change takes time: Understanding and responding to culture change in course redesign. *Scholarship of Teaching and Learning in Psychology, 1*(4), 255-268. doi:10.1037/stl0000043

Kecskemety, K. M., Corrigan, L. N. & Abrams, L. M. (2015). *Inverting the classroom: Balancing individual instructional styles and course standardization*. Paper session presented at Seventh Annual First Year Engineering Experience (FYEE) Conference: Enhancing the First Year of Engineering Education, Roanoke, VA.

Kuhn, K. L., & Rundle-Thiele, S. R. (2009). Curriculum alignment: Exploring student perception of learning achievement measures. *International Journal of Teaching and Learning in Higher Education, 21*(3), 351-361. Retrieved from http://www.isetl.org/ijtlhe/

Lage, M. J., Platt, G. J., & Treglia, M. (2000). Inverting the classroom: A gateway to creating an inclusive learning environment. *Journal of Economic Education, 31*(1), 30-43. doi:10.1080/00220480009596759

Law, W. (2014). Flipping Introduction to MIS for a connected World. *Information Systems Education Journal, 12*(6), 92-100. Retrieved from http://isedj.org/2014-12/

Linder-VanBerschot, J. A., & Summers, L. L. (2015). Designing instruction in the face of technology transience. *Quarterly Review of Distance Education, 16*(2), 107-118. Retrieved from http://www.infoagepub.com/quarterly-review-of-distance-education

Lucke, T., Dunn, P. K., & Christie, M. (2017). Activating learning in engineering education using ICT and the concept of 'flipping the classroom'. *European Journal of Engineering Education, 42*(1), 45-57. doi:10.1080/03043797.2016.1201460

Mitchell, A., Petter, S., & Harris, A. L. (2017). Learning by doing: Twenty successful active learning exercises for information systems courses. *Journal of Information Technology Practice: Innovations in Practice, 16*, 21-26. Retrieved from https://www.informingscience.org/Publications/3643

Mok, H. N. (2014). Teaching tip: The flipped classroom. *Journal of Information Systems Education, 25*(1), 7-11. Retrieved from http://jise.org/index.html

Moravec, M., Williams, A., Aguilar-Roca, N., & O'Dowd, D. K. (2010). Learn before lecture: A strategy that improves learning outcomes in a large introductory biology class. *CBE - Life Sciences Education, 9*(4), 473-481. doi:10.1187/cbe.10-04-0063

Ng, E. M. W. (2016). The flipped classroom: Two learning modes that foster two learning outcomes. *Issues in Informing Science and Information Technology, 13*, 15-23. Retrieved from http://www.informingscience.org/Publications/3462

Patanwala, A. E., Erstad, B. L., & Murphy, J. E. (2017). Student use of flipped classroom videos in a therapeutics course. *Currents in Pharmacy Teaching & Learning, 9*(1), 50-54. doi:10.1016/j.cptl.2016.08.043

Phillips, L., & Phillips, M. (2016). Improved student outcomes in a flipped statistics course. *Administrative Issues Journal: Education, Practice & Research, 6*(1), 88-98. doi:10.5929/2016.6.1.5

Porcaro, P. A., Jackson, D. E., McLaughlin, P. M., & O'Malley, C. J. (2016). *Curriculum design of a flipped classroom to enhance hematology learning. Journal of Science Education and Technology, 25*(3), 345-357. doi:10.1007/s10956-015-9599-8

Pragman, C. H. (2014). Using student feedback to revise a flipped operations management class. *Business Education Innovation Journal, 6*(2), 11-19. Retrieved from http://www.beijournal.com/

Prashar, A. (2015). Assessing the flipped classroom in operations management: A pilot study. *Journal of Education for Business, 90*(3), 126-138. doi:10.1080/08832323.2015.1007904

Reza, S., & Ijaz Baig, M. (2015). A study of inverted classroom pedagogy in computer science teaching. *International Journal of Research Studies in Educational Technology, 4*(2), 19-30. Retrieved from http://www.consortiacademia.org/index.php/ijrset/index

Saulnier, B. (2015). The flipped classroom in systems analysis & design: Leveraging technology to increase student engagement. *Information Systems Education Journal, 13*(4), 33-40. Retrieved from http://isedj.org/

Scanlon, E., McAndrew, P., & O'Shea, T. (2015). Designing for educational technology to enhance the experience of learners in distance education: How open educational resources, learning design and MOOCS are influencing learning. *Journal of Interactive Media in Education, 6*(1), 1-9. Retrieved from http://jime.open.ac.uk/

Sharp, J. H. (2016). The flipped C# programming classroom: What students had to say. *Proceedings of the Second EDSIG Conference on Information Systems and Computing Education, 2*(4032), 1-10. Retrieved from http://proc.iscap.info/2016/

Sharp, J. H., & Schultz, L. A. (2013). An exploratory study of the use of video as an instructional tool in an introductory C# programming course. *Information Systems Education Journal, 11*(6), 33-39. Retrieved from http://isedj.org/

Sharp, L. A., & Sharp, J. H. (2016). Enhancing student success in online learning experiences through the use of self-regulation strategies. *Journal on Excellence in College Teaching, 27*(2), 57-75. Retrieved from http://celt.muohio.edu/ject/

Strayer, J. F. (2007). *The effects of the classroom flip on the learning environment: A comparison of learning activity in a traditional classroom and a flip classroom that used an intelligent tutoring system* (Doctoral dissertation). Retrieved from Ohio State University (ISBN 978-0-549-20548-7).

Strayer, J. F. (2012). How learning in an inverted classroom influences cooperation, innovation, and task orientation. *Learning Environments Research, 15*(2), 171-193. doi:10.1007/s10984-012-9108-4

Swart, W., & Wuensch, K. L. (2016). Flipping quantitative classes: A triple win. *Decision Sciences Journal of Innovative Education, 14*(1), 67-89. doi:10.1111/dsji.12088

Talley, C. P., & Scherer, S. (2013). The enhanced flipped classroom: Increasing academic performance with student-recorded lectures and practice testing in a 'Flipped' STEM course. *Journal of Negro Education, 82*(3), 339-347. doi:10.7709/jnegroeducation.82.3.0339

Tanner, M., & Scott, E. (2015). A flipped classroom approach to teaching systems analysis, design and implementation. *Journal of Information Technology Education: Research, 14*, 219-241. Retrieved from http://www.jite.org

Urbaczewski, A. (2013). Flipping the classroom and problem solving techniques – Observations and lessons learned. *Proceedings of the AIS SIG-ED IAIM Conference,* 1-7. Retrieved from http://aisel.aisnet.org/siged2013/

Wilson, S. G. (2013). The flipped class: A method to address the challenges of an undergraduate statistics course. *Teaching of Psychology, 40*(3), 193-199. doi:10.1177/0098628313487461

Wright, L. K., Newman, D. L., Cardinale, J. A., & Teese, R. (2016). Web-based interactive video vignettes create a personalized active learning classroom for introducing big ideas in introductory biology. *Bioscene, 42*(2), 32-43. Retrieved from http://www.acube.org/bioscene/

Yang, C. C. R. (2017). An investigation of the use of the 'flipped classroom' pedagogy in secondary English language classrooms. *Journal of Information Technology Education: Innovations in Practice, 16*, 1-20. Retrieved from https://www.informingscience.org/Publications/3635

Yelamarthi, K., Drake, E., & Prewett, M. (2016). An instructional design framework to improve student learning in a first-year engineering class. *Journal of Information Technology Education: Innovations in Practice, 15*, 195-222. Retrieved from Retrieved from https://www.informingscience.org/Publications/3617

Yusong, L., & Daher, T. (2017). Integrating innovative classroom activities with flipped teaching in a water resources engineering class. *Journal of Professional Issues in Engineering Education & Practice, 143*(1), 1-6. doi:10.1061/(ASCE)EI.1943-5541.0000297

Zhang, X., Zhang, C., Stafford, T. F., and Zhang, P. (2013). Teaching introductory programming to IS students: The impact of teaching approaches to learning performance. *Journal of Information Systems Education, 24*(2), 147-155. Retrieved from http://jise.org/index.html

APPENDIX A: COURSE CONTENT WITH RELATED TEXTBOOK CHAPTERS AND VIDEO DEMONSTRATIONS

Introduction to Computers and Programming
• Textbook: Chapter 1 • Setting up the Visual Studio Environment (2) • Creating a New Project (11) • Submitting a Project in Blackboard (8)
Introduction to C#
• Textbook: Chapter 2 • Getting Started with Forms (8) • Getting Started with Controls - Buttons (10) • Introduction to C# Code (10) • Working with the MessageBox (8) • Working with the Label Control – Part 1 (9) • Working with the Label Control - Part 2 (9) • Working with the PictureBox Control (9) • Sequence, Comments, & Close Method (11)
Processing Data
• Textbook: Chapter 3 • Text Box Control and Variables (12) • Data Types, Calculations, Input/Output (14) • Named Constants (10) • Exception Handling (9) • Fields (16) • GUI Details (2)
Making Decisions
• Textbook: Chapter 4 • Decision Structures (14) • Logical Operators and the Switch (14) • The TryParse Method (18) • Input Validation (14)
Loops
• Textbook: Chapter 5 • List Box Control (17) • Loops (22) • List Box Control for Output with a Loop (10)
Methods
• Textbook: Chapter 6 • Methods – Part 1 (20) • Methods – Part 2 (12) • Methods – Part 3 (11)
Arrays and Lists
• Textbook: Chapter 7 • Array (21) • List (14)

Other User Interface Controls
• Textbook: Appendix B • Combo Box Control (23) • Menu System (8)

*The number in parentheses is the length of the video in minutes

**In the present study, the authors used Starting Out with Visual C#, 4th Edition, Pearson, 2017, as the textbook.

APPENDIX B: DESCRIPTION OF LAB ASSIGNMENTS AND EXAMS

Item	Description
Lab Assignment 1*	Familiarize the student with the Visual Studio environment and the process for naming and submitting lab assignments as provided in detail in the course syllabus. The lab consists of creating a Visual Studio project using the required naming convention and placing identification information (i.e., name, ID number, due date, date submitted, brief description of program) in comment statements at the top of the program code.
Lab Assignment 2	Demonstrate the use of the following controls: Label, PictureBox, and Button. Implement the Visible property.
Lab Assignment 3	Demonstrate the use of TextBox controls for user input, the use of named constants, declaration of variables, arithmetic calculations, conversion of data using the Parse and ToString methods, simple exception handling with the try-catch statement, and various GUI details such as keyboard access keys and setting the AcceptButton and CancelButton properties of the form
Lab Assignment 4	Demonstrate the use of the appropriate selection structure to prevent data conversion errors using the TryParse method as well as accuracy errors using input validation. The use of appropriate relational and logical operators is also required.
Lab Assignment 5	Demonstrate the use of the appropriate repetition structure as well as prevent data conversion errors and accuracy errors with input validation. The use of appropriate relational and logical operators is also required.
Lab Assignment 6	Demonstrate the use of methods and method calls to pass arguments either by value or by reference and assign values to the associate parameter variables. The program should also prevent data conversion errors and accuracy errors with input validation.
Lab Assignment 7	Demonstrate the use of a List object to store and manipulate values entered by the user.
Exam 1	Demonstrate the use of multiple controls including Labels, Text Boxes, Buttons, and Picture Boxes. The program requires the declaration of named constants and variables, implementation of the try-catch statement and Parse method, formulation of various calculations, and implementation of the ToString method and appropriate conversion characters to display output.
Exam 2	Demonstrate the use of methods by creating the required method calls to pass values by value and/or reference and to assign those values to the associated parameter variables. The program requires the implementation of the TryParse method to prevent data conversion errors and the appropriate selection structure for input validation. Returning of appropriate values with correct data types must also be demonstrated.
Final Exam	Demonstrate the implementation of a List object for storing and retrieving items, Combo Box control, Menu System, and input validation using the TryParse method and appropriate selection structure. Implement counters and accumulators.

*Lab Assignment 1 was not included in analysis of data with the present study because it served as an introduction for students to the course.

BIOGRAPHIES

Dr. Jason H. Sharp is an Associate Professor of Computer Information Systems at Tarleton State University. He earned his Ph.D. from the University of North Texas. Prior to entering academia, he worked as a systems support specialist and developed custom database solutions for small business. His research focuses on systems and software development methods, global agile teams, and instructional design and technology. His work has appeared in such journals as: Informing Science: The International Journal of an Emerging Discipline, Journal of Information Technology Education: Innovations in Practice, Issues in Informing Science and Information Technology, The DATA BASE for Advances in Information Systems, and Journal of Information Technology Management.

Dr. Laurie A. Sharp is the Dr. John G. O'Brien Distinguished Chair in Education at West Texas A&M University in Canyon, Texas. Laurie teaches undergraduate and graduate education and literacy courses, and she also works closely with area public school districts to identify best practices in education. Prior to being a faculty member in higher education, Laurie was an elementary and intermediate level classroom teacher in Florida and Texas public schools. Her research interests include literacy, educator preparation, and learner engagement for all levels of learning. She also serves as an active member and leader within several community and professional organizations.